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THE NEXT CONVOY WAR: THE AMERICAN CAMPAIGN AGAINST ENEMY SHIPPING IN THE TWENTY-FIRST CENTURY

by

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The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy

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In the coming century, the United States may find herself at war with a determined and capable opponent. A campaign against Orange commercial shipping will be a facet of the strategic warfare waged against this opponent.

The Orange nation may attempt to protect her open-ocean trade routes by convoying her merchant vessels, but will find that American naval power in the Age of Network Centric Warfare is too powerful to compete with outside the range of land-based support. The Orange nation will be able to exercise a degree of area denial near her shores, using barrier minefield and land-based air and sea defenses. The American forces will have great difficulty in shutting down the littoral trade routes, due partially to the limitations of weapons technology and partially to the shortage of delivery platforms capable of operation in the Orange denial area. Advanced weapons technology could help improve the success rate, as could a greater attention to offensive naval mining capability.

To maximize the impact of the anti-shipping campaign, American forces should attack Orange ports directly. The Orange nation will respond to American successes by shifting her domestic transport mechanisms to air- or land-based vehicles where practical. This shifting will reduce the impact of the American anti-shipping efforts, unless the American forces also take steps to eliminate the alternate transport methods. If escalation concerns prevent strikes against the Orange homeland, the war against Orange domestic commerce may not be "winnable" at all.

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The primary method, then, in which we use victory or preponderance at sea and bring it to bear on the enemy's population to secure peace, is by the capture or destruction of the enemy's property.

Sir Julian Corbett[1]

I. Introduction

Some time in the next century, the United States may find itself in a prolonged war with a determined and capable opponent. In such a conflict, we will likely engage in a campaign of economic disruption as a part of the strategic war against our foe. This campaign will consist, in part, of operations against enemy shipping. In this essay, I will predict some of the attributes of this operation: the convoy war of the future.

I must make several assumptions about the overall character of this future conflict. First, I must assume that the United States and allied/coalition forces are incapable of large land operations against Orange (the enemy nation). Orange may possess a huge land force; Orange may possess nuclear weaponry that form a major deterrent to invasion of her homeland; we may have no allies adjacent to Orange that are willing to serve as a staging area for accumulation.[2] Orange's relative territorial invulnerability will force the United States into a protracted war of attrition. Second, I must assume that Orange does not possess an open-ocean navy capable of Mahanian fleet-on-fleet engagements against the American fleet. This is a reasonable assumption, in that no nation on Earth is currently willing to make the kind of long-term capital investment required to build a fleet to match what the United States currently possesses. If such a nation were to arise, the United States could certainly match or exceed the Orange buildup. Finally, I must assume that the United States and her allies possess the political will for continuance of the war. This would also include the political will to match any possible fleet buildup by Orange.

II. The Predictions

Prediction #1: *Orange will attempt convoy operations, but will find they are only successful in the coastal waterways.*

Historical experience shows that convoy operations produce maximum survival of friendly transport vessels, and the maximum attrition of the interdicting forces.[3] If Orange intends to continue ocean-going transport during the war, eventually she will try to mass her merchants in a group and will escort the group with warships.

The United States and her allies will deploy naval and air forces to interdict the convoy. One important factor to consider in allocating forces to the convoy mission is the ratio of attackers to escorts; the German experience in the North Atlantic in 1941-1942 illustrates two conclusions: first, the number of convoy ships sunk depends directly on the number of attacking vessels, and second that the convoy loss rate drops off as the number of escort vessels rises.[4] The historical pattern implies that the alliance must increase the level of force until Orange experiences an unacceptable loss rate, and that Orange must commensurately increase the level of escort force to keep the losses within reason. Ultimate victory in the convoy war will therefore go to the side with the deeper pockets - if Orange can augment the escort forces faster than the Americans can increase the interdicting forces, then eventually Orange will triumph. This is at least in part what happened during the Battle of the Atlantic; Allied convoy escorts increased faster than the Germans could put ever larger numbers of U-boats to sea, and eventually the Allies won.[5] Over the long haul, then, the United States is likely to triumph in a war of naval attrition, based on industrial capacity alone. The Orange commander, though, may recognize that the blockading

fleet must of necessity be dispersed in order to cover sufficient area, and may count on local superiority at the convoy perimeter to penetrate the interdicting fleet.

But the Orange commander relying on encountering a dispersed blockade force will discover the radical change twenty-first century warfare brings to convoy operations. With the projected advances in battlespace awareness that the United States will enjoy during the next century, much of the theoretical advantage of the convoy system may be lost. In theory, if a fixed number of randomly moving searchers is enclosed in a volume, the number of intersections with the searched-for prizes will rise or fall directly with the number of prizes in the same volume. Convoy operations rely implicitly on the "big ocean" theory, in that relative to the size of the ocean, a group of twenty ships is not significantly larger than a single ship. The convoy system at least partially owes its success to the reduction in the number of contacts with interdicting vessels, essentially by reducing the number of sites where such contact is possible. But a central tenet of America's future maritime war is battlespace awareness, a concept that involves enhanced tactical reconnaissance and a shared operational picture. I assume that this capability will also include the ability to monitor Orange ports of exit to the extent that the formation and departure of a large convoy will not go unnoticed; once alerted, reconnaissance forces should be able to track the convoy nearly continuously. This practical application of Network Centric Warfare

> . . . is warfare which derives its power from the networking of a well-informed but geographically dispersed force. The enabling elements are a highly-webbed information service, access to all appropriate information sources, weapons reach with precision and speed of response, value-adding command and control processes . . . and integrated sensors.[6]

The problem of interdicting open-ocean commerce is tailor-made for a Network Centric Warfare

force. A combination of submarines, UAV's, manned low-observable aircraft, and satellite imaging systems will be able to monitor the progress of any substantial convoy to a degree that Admiral Doenitz would have sold his left arm for. The interdicting fleet will be able to divert forces allocated to patrolling or to sector search directly to the convoy interception mission, or be able to direct distant fire onto the target without having to intercept at all. This will produce a far larger force on target than would be expected from a set of random encounters; this is wolf-pack operations in the twenty-first century. With knowledge of the convoy's location, the interdiction problem is half solved, and half of the advantage of the convoy has been dissipated. The outcome will be highly unacceptable loss rates for Orange vessels and their escorts, at least in the open-ocean part of the problem.

The half of the convoy advantage which remains is the concentration of friendly protection assets. Not only does this concentration serve to protect the freighters, it also serves as the best means for the transiting force to strike at its opponents. In the Battle of the Atlantic, Allied forces engaged in convoy protection (both surface and air) accounted for sixty-five percent of the total number of U-boats destroyed, whereas only twenty-eight percent could be attributed to area sweeps/patrols and direct attack on U-boat bases.[7] If Orange aims to deplete interdicting forces, the convoy operation provides the best chance. Orange will have limited naval military assets, though, with respect to the American coalition, and in any open-ocean confrontation with the blockading fleet will be seriously overmatched. Convoy protection requires that friendly forces are powerful enough to deny interdiction; an Orange attempt to break the blockade by force will be met, in all probability, with overwhelming naval and air power, vectored into the battlespace through the American network. Given current and projected future American dominance of the

open ocean, the great residual industrial capacity of the United States, and the advances to anti-shipping operations that Network Centric Warfare will bring, I find it implausible that any Orange nation could muster sufficient naval force to keep her open-ocean trade routes open.[8]

In the near-shore trade routes, though, the convoy may be more successful. The Orange escorts will be augmented by a land-based air defense system, possibly denying coalition forces both reconnaissance and air-to-surface ordnance delivery. In the Falkland's War, the presence of British submarines was sufficient to deny the Argentinians access to the area of conflict[9]; if Orange possesses a diesel submarine capability, the presence of these vessels in the inshore region may deter the coalition from aggressive pursuit of Orange merchants. Orange will lay defensive minefields, conduct aggressive air and sea patrols of its littoral, and construct anti-ship missile positions on her coast. American anti-shipping operations in the near-coastal lanes will be less effective due to the increase hostility of the environment, and the limited Orange convoy protection assets may be adequate in the inshore region to defend the convoys against the less effective American threat.

Prediction #2: *Orange will exercise sea denial in the near littoral.*

Fear of American naval and amphibious power will likely drive Orange to plant defensive mine barriers near her shores. Historically, defensive minefields have been used by combatants desiring to reduce the threat of naval power projection; at the outbreak of World War I, the Russians laid some 2200 moored mines at the entrance to the Gulf of Finland to protect St. Petersburg from attack from the sea, and supplemented these fields by additional mines off the Latvian coast.[10] In the Second World War, the United States laid 3460 mines in a defensive field

around Key West,[11] and the British laid extensive mine barriers along their North Sea littoral "to help protect the heavy flow of shipping passing up and down the length of our [British] east coast. . . . The mine barrier would give close control over our own shipping and make it easier to detect and deal with any enemy who might try to interfere with our traffic."[12]

In the next war against maritime trade, Orange will likely use a pattern of barrier minefields, shore-based anti-ship weapons systems, and local air superiority to deny entry into the littoral seas. The current Navy Operational Concept assumes that we will overcome Orange sea denial capabilities, and argues that a robust Orange denial capability is actually to our advantage:

> Our ability to counter enemy area-denial threats effectively with potent information warfare, power projection and force-protection capabilities increases our decisive impact early in a joint campaign. The more an enemy depends on denial capabilities to achieve his objectives, the greater our impact when we defeat those capabilities.[13]

This is highly optimistic. There are at least a half-dozen nations or possible blocs in the world today that could put up a credible long-term area denial force off their shores.[14] To assert that the United States forces will be able to go anywhere at will neglects not only current worldwide capabilities but fails to account for technological advancements outside the United States. For example, our current advantage in "stealth" technology cannot be maintained indefinitely; it is probable that in the near future, other nations may develop weapons systems that incorporate "low-observable" features.[15] American forces will be incapable of conducting mine clearance operations in an area routinely patrolled by Orange stealth fighters. It is not unreasonable to conclude that Orange will therefore be capable of denying American access to her littoral seas.

Given, then, that Orange sea denial efforts will be at least partially successful, prosecution

of the near-shore anti-shipping campaign becomes difficult, and convoy operations in this region more successful. American and coalition platforms chosen to prosecute the campaign must be capable of covert or stealthy operations; submarines, special forces teams, and stealth aircraft are obvious choices.

Prediction #3: *Orange will shift goods to non-maritime conveyances and possibly to a larger number of smaller ships.*

If the American fleet successfully disrupts the standard freighter traffic, Orange must find alternate means to ship goods. Many low-mass, high-value commodities may be shipped by air freight: optical equipment, integrated circuity, electronics packages, munitions, and medical equipment, to name just a few. It will not be possible to shut down air transport within the Orange nation, but some form of air interdiction may be possible on the perimeter, outside of the region of Orange air superiority.

Rail transport is a viable alternative to coastal shipping for transport of bulk goods between points within a nation. At the first signs of trouble in the coastal trade routes, Orange will likely shift much of her transport to rail. This is exactly what the United States did in the summer of 1942; when U-boats sunk large numbers of tankers in the exit lanes from the Caribbean, America shifted over to rail for shipment of petroleum products.[16] For the Joint Force Commander's mission to be truly successful, American forces must be able to successfully interdict this land-based shipment system.

Shifting to larger numbers of smaller transport vessels has the advantage of minimizing the loss of material if any single vessel is sunk. A larger number of targets also implies that the

interdicting forces will have to expend a larger amount of ordnance to achieve an equivalent level of tonnage. Smaller vessels are likely to be easier to replace, both in terms of resources and personnel required. On the negative side, more shipping vessels implies that port facilities will be more crowded, and the overall transshipment rate may be lower for a given number of berths in the port. Whether Orange finds it profitable to shift to a more dispersed seaborne trade configuration will depend on the American force's ability to disrupt port operations; if the ports remain relatively untouched, while vessels in transit are at hazard, we can expect to see the tonnage of an average coastal merchant go down.

Prediction #4: *The United States must conduct port closure operations.*

American and allied forces must attempt to close the ports of trade as part of the campaign against maritime trade. For trade to be successful, the trading partners must have ports at which to load or offload goods; denying Orange the use of her ports will further reduce trade beyond the reductions achieved by the anti-shipping operations. Admiral Bogolepov, a Soviet officer who analyzed the anti-shipping campaigns of the Second World War, noted that "an indubitable flaw in German strategy was the fact that during the course of sea-lane operations no purposeful, massed and systematic strikes were made on cargo ports. Even in the summer and fall of 1940, when it seemed that the entire might of the Luftwaffe was pummeling England, the objective of the raids was not to stop shipping to and from England."[17]

The American coalition will use air-dropped precision guided munitions, cruise missiles, and mines to close the ports. The range of current cruise missiles will allow us to launch them from outside the Orange defense perimeter; these missiles will be suitable for fixed targets only,

and built-up port facilities are an ideal target set. The Joint Forces Commander may elect airstrikes or airborne mine delivery in the efforts to close Orange ports. Given Orange area denial abilities, airborne delivery platforms should have stealth features if they will enter into Orange airspace.

The preferred weapon for port closure operations may be the naval mine. It has several advantages: it can be delivered covertly, it does not require a friendly platform in the area to trigger it, it need not involve casualties to be effective, and individual munitions are relatively inexpensive. Drawbacks to an offensive mine campaign include a need for continual replenishment, difficulty of delivery, and the indiscriminate nature of the casualties inflicted.

Prediction #5: *Political factors may inhibit the conduct of the campaign.*

Our National Command Authority may place restrictions on strike warfare against the Orange homeland. One factor will be the reluctance of the American people to tolerate civilian casualties, since strikes inevitably kill noncombatants. Another factor mitigating strike is the Orange nuclear option; the NCA may hesitate to attack the Orange homeland if they are unsure of the Orange response. This is one of the reasons why an offensive mining campaign may be the most practical -- strike warfare involves a direct attack on the Orange homeland that occurs without warning, whereas a minefield is a far more passive kind of attack that may be less likely to provoke an escalatory response. With sufficient warning, naval mines need not inflict any casualties at all.

The American public has developed a low tolerance for casualties; in several recent engagements, the loss of American lives has been the triggering event for American withdrawal

from the theater.[18] This may be in part due to television coverage, or may be more a function of the relative importance of the military action with respect to vital national interests. It is reasonable to assume that the American public would accept a higher casualty rate in a contest where the "American way of life" or national survival were at stake than in a conflict whose resolution was less vital. In a protracted war against Orange commerce, we will suffer casualties if we attempt to penetrate into the Orange littoral. Given our current naval superiority, and the likelihood that this superiority will be maintained, the casualty rate in the open ocean may be fairly low; the losses will come largely from the submarines and aircraft that conduct operations within the Orange defense zone. The Joint Forces Commander must judge the risk of loss of a submarine or aircraft against the gain to be achieved through the suppression of commerce which that platform can accomplish.

Prediction #6: *The United States will need multiple delivery platforms and new weapons systems to prosecute the campaign effectively.*

The Joint Forces Commander prosecuting the war against Orange shipping will need to ensure a thorough meshing between the air and naval components of his forces. The effectiveness of Network Centric Warfare depends heavily on the intercommunication and the interoperability of the different platforms; failure to integrate will mean failure overall. In the Second World War, ". . . attack force coordination, particularly between submarines and aircraft, remained a weak point with Germany and Italy. The lack of aircraft at the disposal of the German Naval Command, particularly reconnaissance aircraft, led to considerable difficulties in the search for enemy convoys in the Atlantic with a limited submarine fleet."[19] The Nazis had plenty of aircraft,

but they were not under the command of the Navy, and no mechanism existed to balance the demands on the Luftwaffe between the Navy and the Army. To conduct an effective anti-convoy campaign, the air arm must be integrated with the naval arm.

Current weaponry problems may also increase the viability of Orange shipping, particularly in coastal convoys. For example, shallow water acoustic problems may reduce the effectiveness of our torpedoes. These problems accrue from the great difficulty of the acoustic environment in shallow water conditions: large amounts of coastal shipping traffic and biological activity increase the background noise; active sonar interpretation becomes more complex as the number of false returns from bottom features goes up; mixing of freshwater runoff with the saltwater may cause sharp salinity and temperature gradients. What this means to the commander is that a submarine sent into the Orange area denial zone on an anti-shipping mission will achieve fewer kills per weapon, and the risk/reward balance of the mission is thereby skewed.

Our anti-ship cruise missiles will be less effective when fired toward the land due to the large number of false targets the missiles could acquire. A major problem with prosecuting inshore shipping with anti-ship cruise missiles is the inability of the missile seeker to consistently pick the desired target out of the background land clutter. There are several possible solutions to this problem; one would be the development of a missile with enhanced radar[20], another would be the development of an extremely cheap missile that could be manufactured and launched in large numbers.

America's best weapon for closing the inshore routes could be the bottom mine: "The actual planting of mines (or even the intimation that mines have been sown) is usually sufficient to stop maritime traffic at a port. . . . Covert mining provides the option of closing ports in support

of either blockade or conflict."[21] Offensive mine warfare certainly had its place in previous wars; in the May-August 1945 period, for example, Japan lost 153 vessels to American mines, more than a third of all vessels sunk during that period. Over the war as a whole, the British lost over a million tons of merchant tonnage to mines, plus 281 warships, while the Germans lost over 500 warships to the same cause.[22]

But the American military does not seem to be interested in offensive mining operations. The 1998 Department of the Navy Posture Statement makes no reference at all to this feature of warfare; the Navy's attitude toward mine warfare is that it is "integral to the ability of naval forces to open and maintain sea lines of communication and to dominate the littoral battlespace."[23] According to this document, the Navy is not developing any new mines or mine delivery platforms, and focuses exclusively on minehunting and mine removal operations. If we find ourselves engaged in a lengthy war, a war in which the closing of enemy ports becomes important, we will need naval mines to do the job. In the mining offensive against Japan in the closing days of World War II, it took about 38 mines to sink or damage one enemy ship.[24] In the face of aggressive Orange mine clearance operations, American forces will be hard pressed to maintain a viable minefield at a level dense enough to cause the requisite damage.[25] Part of the problem will be a shortage of mine delivery platforms. Given the self-defense and strike missions a sub in theater must support, a single submarine operating in Orange littoral waters isn't likely to carry enough mines to do the job. Multiple submarines will be needed, but may not be available. Airdropped naval mines will also do the job, but given expected Orange air defense capabilities and the current and projected inventory of B-2 bombers, the United States will also lack an adequate number of capable platforms to execute an effective aerial mining campaign.

III. Conclusion

In the future war against seaborne commerce, the United States will dominate the open ocean. We already possess a blue-water naval capability far in excess of any competitor, and no nation in the future will be likely to undertake a naval construction program which we cannot match. Our aerial and space reconnaissance capabilities are without peer and are likely to remain so. Technological advancements in platform networking and interoperability will result in enhanced ocean awareness and in a high level of effectiveness of our open ocean blockade.

In the enemy's littoral seas, though, we can expect the Orange nation to be able to deny us entry. Shutting down the near-shore freight transit routes will therefore be a much more difficult problem. A combination of littoral mining, anti-merchant engagements using missiles and torpedoes, and port disruption efforts will be needed for the operation to be successful. Limitations on these forms of attack will reduce the overall effectiveness of the campaign; these limitations may be technical, political, or matters of scale.

The Joint Forces commander must keep the pressure on -- Orange will recover port operability if disruption efforts are not maintained. We cannot lay a minefield, then abandon it and expect it to still be functioning two weeks later; we cannot destroy a pier without expecting Orange to rebuild it.

The anti-shipping campaign will last for months, if not years. Its impact on the war may not be immediately obvious, but may only manifest itself in a gradual degradation of Orange military capability. The campaign will involve repeated missions against the same targets, and may result in the loss of several submarines or aircraft.

Measures of effectiveness of the anti-shipping campaign should focus on the transhipment

rate of Orange ports. More important than tonnage sunk or numbers of vessels diverted, the rate of seaborne commodity transfer in Orange ports will indicate the relative success of the mission. As part of the campaign, the Joint Forces Commander should ensure the alternate routes for goods and commodities are also disrupted. If the campaign is limited for political reasons to over-water actions only, the impact of the shipping suppression campaign will be mitigated by Orange's transferral of transport to non-naval conveyances.

In the final analysis, the war against Orange near-shore shipping may not be "winnable" at all. If Orange relies heavily on inshore traffic, American forces will have to inflict a large number of casualties to cause a significant percentage reduction in commerce,[26] and the Joint Forces Commander may not have enough advanced weapons or delivery systems to inflict the necessary level of casualties. If Orange has little reliance on domestic maritime trade, shutting it down completely will have little strategic impact. The open seas, though, will remain in American hands; in the convoy war of the future, we can deliver a near total elimination of the Orange international sea trade. In the convoy war of the future, the only convoys that will ply the high seas will be American.

ENDNOTES

1. Sir Julian Corbett, Some Principles of Maritime Strategy (London: Longmans, Green, and Co., 1911; reprint, Annapolis: Naval Institute Press, 1988), 99.

2. The nuclear deterrent need not be indigenous to Orange; it could be wielded on her behalf by a third party.

3. Peter W. Gretton, "Why Don't We Learn from History" (Newport RI: Naval War College, 1961), 15 and 20.

4. Department of the Navy, Office of the Chief of Naval Operations, Operations Evaluation Group Study No. 515: A Study of Convoy Routing (Washington DC: Office of the CNO, 21 December 1953), 10-11.

5. This is a bit of an oversimplification, but correct in its essence. The Battle of the Atlantic was lost to the Axis for a number of reasons, among which we can count the imbalance between the number of U-boats and the number of convoy escort vessels. Other reasons include Axis doctrinal and organizational faults, superior Allied technology, and the diversion of Nazi war material to the land war in Russia.

6. Department of the Navy, 1998 Posture Statement: Forward . . . From the Sea: Anytime, Anywhere (Washington DC: Department of the Navy, 1998), 40.

7. Gretton, 14. The statistics cover the crucial period 9/39 - 5/43.

8. This view is echoed by the Office of the CNO: "With the exception of the former Soviet Navy, no nation's forces now or in the foreseeable future can challenge our global sea supremacy -- the cost of developing such a navy is too great." [Department of the Navy, Assistant Chief of Naval Operations for Undersea Warfare, "Submarine Roles in the 1990's and Beyond" (Washington DC: Office of the Asst CNO for USW, 1992), 23.]

9. Department of the Navy, Assistant Chief of Naval Operations for Undersea Warfare, "Submarine Roles in the 1990's and Beyond" (Washington DC: Office of the Asst CNO for USW, 1992), 14.

10. Gregory K. Hartmann and Scott C. Truver, Weapons that Wait: Mine Warfare in the U.S. Navy (Annapolis, MD: Naval Institute Press, 1991), 42.

11. Ibid, 68. This field claimed no Axis victims, but did sink three American merchants and damage one American destroyer.

12. S. W. Roskill, CAPT, RN, The War at Sea 1939-1945 (London: Her Majesty's Stationery Office, 1954), 125.

13. Department of the Navy, Chief of Naval Operations, Forward . . . From the Sea: The Navy Operational Concept, March 1997. <www.chinfo.navy.mil/navpalib/policy/fromsea/ffseanoc.html> (28 Mar 1997).

14. To wit: a rump NATO without the USA, Russia alone or with her former Soviet clients, China alone or in coalition with Japan, a Japanese coalition with a reunited Korea, India, a Pan-Arab power spanning the Persian Gulf (especially if supported by France or Russia).

15. I base this assertion on the observation that technological developments accelerate once the feasibility of the advance is demonstrated. Once the engineers know a thing is possible, all that remains is actually doing it. Note the rapid advance in the American space program after Sputnik, the creation of powered flight, or the development of the nuclear power industry.

16. V. P. Bogolepov, Rear Admiral Soviet Navy, ed., Blockade and Counterblockade: Struggle on the Ocean-Sea Lanes in World War II (Moscow: Nakua Publishing House, 1970), 77.

17. Ibid, 111.

18. Lebanon and Somalia are specific examples. Additionally, much of the argument against intervention in Kuwait in 1990 centered on the anticipation of large numbers of dead Americans.

19. Bogolepov, 31.

20. One possible enhancement would be a doppler discriminator; the inclusion of zero-doppler reject features would prevent the missile from homing on any target that is not showing motion along the missile's flight path. The advantage of this approach could be offset by the narrower aspect of the target; the maximum seeker return would be obtained when the target presented a broad aspect to the missile, but this relative position would show low doppler and could possibly be rejected by the advanced missile. In the littoral environment, when most missile shots would likely be broadside, the doppler feature would probably not be effective. Another possibility is a seeker that constructs in its onboard processor projected tracks of possible targets, given its own relative motion, and rejects targets that show no independent velocity vector. This would allow the missile to home on anything moving, but may be more complex and/or expensive to develop.

21. Department of the Navy, Assistant Chief of Naval Operations for Undersea Warfare, "Submarine Roles in the 1990's and Beyond" (Washington DC: Office of the Asst CNO for USW, 1992), 13.

22. Bogolepov, 45 and 54.

23. Department of the Navy, 1998 Department of the Navy Posture Statement: Forward . . . From the Sea: Anytime, Anywhere (Washington DC: Department of the Navy, 1998), 55.

24. Bogolepov, 45.

25. According to Admiral Bogolepov, the low mine loadout of the German U-boat and the low number of U-boats dedicated to mining were the primary factors in the failure of the German submarine mining effort against British ports. (Bogolepov, 59)

26. Corbett stated this principle as "[T]he vulnerability of trade is in inverse ratio to its volume." (Corbett, 278)

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